TITLE OF THE INVENTION

INFORMATION RELEVANCE DISPLAY METHOD, PROGRAM,

STORAGE MEDIUM AND APPARATUS

5 BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates generally to an
information relevance display method, program,
storage medium and apparatus which perform network
10 display of commonality between pieces of element
information by utilizing relevance according to
attributes possessed by element information such
as gene information, and more specifically, to an
information relevance display method, program,
15 storage medium and apparatus which display the
relevance with the network in which elements are
connected as nodes by edges of common attributes.

2. Description of the Related Art

Traditionally, in the field of bioinformatics,
20 starting with sequence analysis of human genome,
the genome sequence analysis of animals other than
human, plants, micro-organisms and the like is
currently underway, and these genome sequence data
is registered in databases which are administered
25 by public institutions of countries, published
through the internet to all over the world and
utilized extensively. Usually, in bioresearch,

properties for each gene, such as what functions it has, where in the body it works and what proteins it generates, are examined and stored in public sites and local sites all over the world. In this

5 case, the genes which have the same properties are considered to play the same role, and researchers strive to predict what role the newly discovered genes play and to identify genes associated to disease, as they repeat experiments based on these

10 information analysis and analysis.

However, in these traditional genome researches, for genes disclosed as the genome sequence data, researchers examined in what way the relevance (commonality) of each data exists by

15 looking into individual data, and problem exists in that it is difficult for analysts to focus attention on the relevance, especially the commonality, of certain gene, as they cover huge volumes of data, and to look into and intuitively

20 capture characteristics thereof. These problems also exit in the data analysis in various fields in which it is needed to intuitively capture the commonality of individual data and other data, covering huge volumes of data other than

25 bioinformatics.

SUMMARY OF THE INVENTION

According to the invention there is provided
an information relevance display method, program,
storage medium and apparatus which perform the
display enabling the relevance of data to be
5   comprehended visually and intuitively.

In order to achieve the above object, according
to a first aspect of the present invention there
is provided an information relevance display method
comprising:

10   a search designation step which, by a search
designation unit, designates element information
and attribute information;

a relevance information extract step which, by
a relevance information extract unit, extracts
15 attributes common to two pieces of element
information as relevance information from
possessed attributes of plural pieces of element
information designated in the search designation
step;

20   a first network display step which, by a first
network display unit, displays a first network by
arranging and displaying, for the element
information and the attribute information
designated in the search designation step, the
25 element information as element nodes, and by
connecting with edges two element nodes possessing
common attribute information by referring to the

relevance information; and

a second network display step which, by a second network display unit, displays a second network by converting possessed attributes of the

5 element nodes in the first network into a display of attribute nodes for arrangement and by connecting with edges the element nodes and the attribute nodes of the possessed attributes thereof.

10 According to the relevance information display of the invention, a first network is displayed, in which two (2) nodes with common attributes are connected by a line defined as an edge in the situation that a plurality of element nodes are

15 arranged, for example, in a circle, and nodes at which the edges are concentrated can be comprehended as the nodes with high commonality at a glance and can be comprehended as notable elements. Adversely, for nodes with extremely less edges, low

20 commonality can be comprehended.

Also, though attributes constitute the edges which connect the element nodes in the display of the first network, it is possible to change into the display of a second network in which these

25 attributes which the edges have are converted into attribute nodes and connected to the element nodes which possess attributes for the attribute nodes

by the edges, and it is possible to intuitively comprehend commonality to the element nodes when the attributes are looked from the viewpoint of nodes.

5   At this point, the first network display step is characterized in that a plurality of the element nodes is arranged uniformly. With this uniform arrangement of the element nodes, it is possible to intuitively comprehend the distribution in

10   connection status of edges which connect between the element nodes according to common attributes, as the density of the edges.

In the first network display step, it may be possible to arrange the element nodes depending on

15   the degree of strength of the commonality, such as the number of the common attributes. For example, when the number of the common attributes is higher, a distance from other element nodes is shortened, and the strength of the commonality is emphasized.

20   · In the second network display step, the attribute nodes are arranged based on distances corresponding to position information for an attribute hierarchical structure. For example, the attribute nodes are arranged in proportion to the

25   distance in the hierarchical structure, making it possible to intuitively comprehend that the distance is shorter, the relevance is higher.

In the second network display step, the
attribute nodes are arranged by finding distances
corresponding to position information for the
attribute hierarchical structure to which
5   predefined weight is added. With this weight, it
is possible to display such that certain
commonality is emphasized manually or
automatically.

In the second network display step, the second
10 network is displayed by converting and arranging
the common attributes represented by all or some
of the designated edges in the first network into
display of the attribute nodes and by connecting
the element nodes and the attribute nodes for the
15 possessed attributes thereof with the edges. In
this way, the second network display is performed,
in which only some of the edges are converted into
the attribute nodes in the first network display,
and it is possible to perform the mixed display of
20 the first network and the second network.

In the search designation step, a select list
for element information and a select list for
attribute information represented by a
hierarchical structure are displayed in the screen
25 displaying the first network or the second network,
and selective designation of the element
information and/or the attribute information is

prompted. Therefore, users can display the
network of relevance and perform analysis work for
notable characteristics, as they accordingly
designate the element information and the attribute
5   information designations.

To achieve the above object, according to a
second aspect of the present invention there is
provided a program for information relevance
display executed by a computer. The program allows
10   the computer to execute:

a search designation step which designates
element information to be searched in an element
information file that stores element information
including element names to be searched and
15   possessed attributes, as well as attribute
information in an attribute information file which
stores attribute information including attribute
names;

a relevance information extract step which
20   extracts attributes common to two pieces of element
information as relevance information from
possessed attributes of plural pieces of element
information designated in the search designation
step;

25   a first network display step which displays a
first network by arranging and displaying, for the
element information and the attribute information

designated in the search designation step, the element information as element nodes and by connecting with edges two element nodes possessing common attribute information by referring to the

5   relevance information; and

a second network display step which displays a second network by converting possessed attributes of the element nodes in the first network into a display of attribute nodes for arrangement and by

10 connecting with edges the element nodes and the attribute nodes of the possessed attributes thereof.

To achieve the above object, according to a third aspect of the present invention there is

15 provided a computer-readable storage medium which stores a program for the information relevance display executed by a computer. The record medium stores a program therein which allows the computer to execute:

20 a search designation step which designates element information in an element information file that stores element information including element names to be searched and possessed attributes, as well as attribute information in an attribute

25 information file which stores attribute information including attribute names;

a relevance information extract step which

extracts attributes common to two pieces of element information as relevance information from possessed attributes of plural pieces of element information designated in the search designation

5   step;

a first network display step which displays a first network by arranging and displaying, for the element information and the attribute information designated in the search designation step, the

10   element information as element nodes and by connecting with edges two element nodes possessing common attribute information by referring to the relevance information; and

a second network display step which displays

15   a second network by converting possessed attributes of the element nodes in the first network into a display of attribute nodes for arrangement and by connecting with edges the element nodes and the attribute nodes of the possessed attributes

20   thereof.

To achieve the above object, according to a fourth aspect of the present invention there is provided a search information relevance display apparatus comprising:

25   an element information file which stores element information including element names to be searched and possessed attributes;

an attribute information file which stores attribute information including attribute names;

a search designation unit which designates element information in the element information file and attribute information in the attribute information file;

a relevance information extract unit which extracts attributes common to two pieces of element information as relevance information, from possessed attributes of plural pieces of element information designated by the search designation unit;

a first network display unit which displays a first network by arranging and displaying, for the element information and the attribute information designated by the search designation unit, the element information as element nodes, and by connecting with edges two element nodes possessing common attribute information by referring to the relevance information; and

a second network display unit which displays a second network by converting possessed attributes of the element nodes in the first network into a display of attribute nodes for arrangement and by connecting with edges the element nodes and the attribute nodes of the possessed attributes thereof.

The details of the program, storage medium and information relevance display unit of the present invention will become essentially the same as those of the information relevance display method.

5   The above and other objects, aspects, features and advantages of the present invention will become more apparent from the following detailed description when taken in conjunction with the accompanying drawings.

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BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram showing an embodiment of an information relevance display apparatus with a function structure thereof according to the
15   invention;

Fig. 2 is a schematic diagram of hardware environment of a computer to which the information relevance display apparatus of FIG. 1 is applied;

Fig. 3 is a schematic diagram of a display
20   screen displaying a first network according to the invention;

Fig. 4 is a schematic diagram of element information stored in the element information file of Fig. 1;

25   Fig. 5 is a schematic diagram of attribute information stored in the attribute information file of Fig. 1;

Fig. 6 is a schematic diagram of relevance information stored in the relevance information file of Fig. 1;

Fig. 7 is a schematic diagram of display of a

5   second network according to the invention, in which all the edges of Fig. 3 are converted to attribute nodes;

Fig. 8 is a schematic diagram of arrangement distance of the attribute nodes in Fig. 7;

10   Fig. 9 is a schematic diagram of display of the second network according to the invention, in which some edges of Fig. 3 are converted to attribute nodes;

Fig. 10 is a flowchart of an information

15   relevance display process according to the invention;

Fig. 11 is a flowchart of the first network display process in Fig. 10;

Fig. 12 is a flowchart of the second network

20   display process in Fig. 10;

Fig. 13 is a schematic diagram of a display screen of the first network in the case that the invention is applied to the relevance display of gene information;

25   Fig. 14 is a schematic diagram of display screen in which certain attribute edges are converted into attribute nodes in Fig. 3 and the

second network is partially displayed; and

.Fig. 15 is a schematic diagram of display
status of check boxes displayed in the attribute
information display list of Fig. 13.

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DESCRIPTION OF THE PREFERRED EMBODIMENTS

Fig. 1 is a block diagram showing an embodiment
of an information relevance display apparatus with
a function structure thereof according to the
10 invention. In Fig. 1, the information relevance
display apparatus 10 of the invention is achieved
by a personal computer and, for example via the
internet 12, able to connect to databases 14-1, 14-2
and 14-3 of public sites, collects search target
15 data from the databases 14-1 to 14-3 and executes
a display process for information relevance. As
these search target data collected from the
databases 14-1 to 14-3, for example gene
information published in bioinformatics field may
20 be quoted. The information relevance display
apparatus 10 is provided with a search information
management section 11, and to the search
information management section 11, an element
information file 16-1, an attribute information
25 file 18-1, a relevance information file 20-1, an
input device 22 such as a keyboard and a tablet and
a display 24 are connected. In order to achieve

the information relevance display process
according to the invention, the search information
management section 11 is provided with a search
information input unit 26, a search designation

5   unit 28, a relevance information extract unit 30,
a first network display process unit 32 and a second
network display process unit 34, as functions to
be achieved by execution of programs. With the
access to the databases 14-1 to 14-3 via the

10   internet 12, the search information input unit 26
inputs the element information including element
names and possessed attributes and stores into the
element information file 16-1, and simultaneously
inputs the attribute information including

15   attribute names and position information for an
attribute hierarchical structure and stores into
the attribute information file 18-1. The search
designation unit 28 designates plural pieces of the
element information and the attribute information

20   based on operations of the input device 22. The
relevance information extract unit 30 extracts
common attributes for two (2) element information
as relevance information from the possessed
attributes of the plural pieces of the element

25   information designated in the search designation
unit 28, and stores into the relevance information
file 20-1. The first network display process unit

32 arranges and displays the element information designated in the search designation unit 28 as the element nodes on the display screen of the display 24, as well as displays the first network in which

5   two (2) element nodes having common attribute information are connected by the edge with reference to the relevance information in the relevance information file 20-1. The edge herein is a line with an orientation which defines one

10 element node as a connection source and other element node as a connection destination, and in following description, though this is defined as the edge, it represents a linear route which connects nodes in a network. The second network

15 display process unit 34 converts and arranges the possessed attributes of the element nodes into the display of the attribute nodes in the first network displayed on the display 24 by the first network display process unit 32, and displays second

20 network by connecting between the element nodes and the attribute nodes for the possessed attributes thereof with the edges. In other words, the second network display process unit 34 converts the edges into the attribute nodes by filtering the edges of

25 the first network displayed by the first network display process unit 32, and performs the network display in which notable attributes are emphasized

hereby. The personal computer which achieves the information relevance display apparatus 10 of the invention in Fig. 1 is, for example, achieved by hardware resources of a computer as shown in Fig.

5   2.

   In the computer of Fig. 2, a bus of CPU 100 is connected with RAM 102, a hard disk controller (software) 104, a floppy disk driver (software) 110, a CD-ROM driver (software) 114, a mouse controller

10   118, a keyboard controller 122, a display controller 126 and a communication board 130. The hard disk controller 104 is connected with a hard disk drive 106 and loaded with an application program which executes the information relevance

15   display process of the invention, and by calling a necessary program from the hard disk drive 106 at startup of the computer, deploying the program on RAM 102 and executing it in CPU 100, the information relevance display by the display

20   controller 126 is performed. The floppy disk driver 110 is connected with a floppy disk drive (hardware) 112 and can read from and write to a floppy disk (R). The CD-ROM driver 114 is connected with a CD drive (hardware) 116 and can

25   read data and programs stored in CD. The mouse controller 118 transfers input operations with the mouse 120 to CPU 100. The keyboard controller 122

transfers input operations with the keyboard 124
to CPU 100. The display controller 126 performs
the display on the display unit 128. The
communication board 130 uses a communication line

5   132, collects information from the databases via
networks such as the internet and communicates with
other computers or servers.

Fig. 3 is a block diagram of a display screen
36 of the information relevance which is displayed

10   on the display 24 by the first network display
process unit 32 of Fig.1. In this display screen
36, centering on a network display area 38, a
element information list 42 is displayed on the
underside, as well as an attribute information list

15   44 represented by a hierarchical directory
structure is displayed on the left side , and an
attribute appearance frequency list 45 is displayed
under it. Also, a filtering button 38-1 and a
layout button 38-2 is provided at upper left corner

20   of the network display area 38; by manipulating the
filtering button 38-1, the first network 40 as shown
or the second network is displayed in the network
display area 38 based on designations of search
targets; and by manipulating the layout button 38-2,

25   the element nodes and the attribute nodes are
arranged depending on degrees of commonalities of
the edges and weighting.

This displayed information on the display
screen 36 of the search information relevance
display in Fig. 3 is based on element information
16 in Fig. 4, attribute information 18 in Fig. 5

5   and relevance information 20 in Fig. 6. The
element information 16 in Fig. 4 consists of element
ID 50, element names 52, possessed attributes 54
and element node display flags 55. The element
information 16 is generated on the element

10   information file 16-1 based on obtaining of search
target data from the databases 14-1 to 14-3 by the
search information input unit 26 provided to the
search information management section 11 of Fig.
1. The element node display flags 55 in the element

15   information 16 are set to a display flag = 1 for
the elements designated as the search targets by
processes in the search designation unit 28, based
on the designation of the elements which are
designated as the search targets by a user with the

20   input device 22. The attribute information 18 in
Fig. 5 is consists of attribute ID 56, attribute
names 58, end flags 60, parent attributes 62,
attribute information search flags 63 and attribute
node display flags 64. At this point, when the

25   attribute information 18 is represented using the
attribute names 58, it has the hierarchical
structure as shown in the attribute information

list 44 in Fig. 3. This hierarchical structure is
defined by the end flags 60 and the parent
attributes 62. The attribute information search
flags 63 are set to a search flag = 1 for the

5   attributes designated as the search targets by
processes in the search designation unit 28, based
on the designation of the attributes which are
designated as the search targets by a user with the
input device 22. The attribute node display flags

10   64 are set to 1 in order to indicate attributes which
are displayed as the attribute nodes in the second
network.

The relevance information 20 in Fig. 6 is
consists of relevance ID 65, connection source

15   nodes 66 indicated by "From", connection
destination nodes 68 indicated by "To", common
attribute ID 70, edge display flags 72 and edge
coupling strength 74. This relevance information
20 holds common attributes of two (2) elements which

20   is obtained by referring to the possessed
attributes 54 of each elements in the element
information 16 of Fig. 4, as the common attribute
ID 70. For example, for R001 of the relevance ID
65 in the relevance information 20, when looking

25   at the relevance of the element ID = N001 of the
connection source nodes 66 and the element ID = N002
of the connection destination nodes 68 in the

element information 16 of Fig. 4, two (2) attribute

IDs, V003 and V005, out of the possessed attributes

54 of each ID are common, and these are stored in

the common attribute ID 70 in the relevance

5 information 20 of Fig. 6. The edge display flags

72 are set to 1 if the edge display is performed

in the network display, and set to 0 if it's not

performed. The set status of the edge display

flags 72 in the relevance information 20 of Fig.

10 6 is the set status of the display flags for the

display of the second network. As opposed to this,

in the first network display status, the attribute

node display is not performed and only the display

of the element nodes is performed, therefore the

15 inverse relevance occurs, wherein 0 in the edge

display flag 72 will be 1 and 1 will be 0. The edge

coupling strength 74 can be configured manually or

automatically by calculations. In the automatic

configuration by calculations, for example values

20 corresponding to the number of the common

attributes or the strength of the commonality are

configured. This value of the edge coupling

strength is utilized as the weight to correct the

relevance in uniform arrangement of the element

25 nodes in the first network.

The first network 40 displayed in the network

display area 38 on the display screen 36 of Fig.

3 is displayed based on the element information 16,
the attribute information 18 and the relevance
information 20 of Fig.4, Fig. 5 and Fig. 6,
respectively. In the first network 40, for the

5   elements for which the element node display flag
55 is set to 1 in the element information 16 of Fig.
4, the elements nodes 46-1, 46-2 and 46-3 are
uniformly arranged, for example, in a circle shape.

This arrangement of the element nodes 46-1 to

10   46-3 may be corrected by using the values of the
edge coupling strength 74 in the relevance
information 20 as the weights. For example, by
checking the number of the common attribute IDs 70
in the relevance information 20, arrangement

15   corresponding to this number of the common
attribute IDs may be used. For the element nodes
46-1 to 46-3 arranged in the first network 40, "Node
1", "Node 2" and "Node 3" are displayed respectively,
according to the element names 52 in the element

20   information 16. The element nodes 46-1 to 46-3 in
the arrangement display are connected with the
edges 48-1, 48-2 and 48-3 based on the common
attribute IDs 70 in the relevance information 20
in Fig. 6. The edge 48-1 represents the common

25   attributes V003 and V005 which are possessed by the
element nodes 46-1 and 46-2 herein. Also, the edge
48-2 represents the common attribute V005 which are

possessed by the element nodes 46-2 and 46-3.
Further, the edge 48-3 represents the common
attributes V002 and V005 which are possessed by the
element nodes 46-1 and 46-3. At this point, in the
5   element information list 42 and the attribute
information list 44 on the display screen 36 of Fig.
3, check boxes are provided to the element IDs and
the attribute names respectively, and the element
information and the attribute information to be the
10   search targets are designated using these check
boxes. The check box in the attribute information
list 44 may indicates three (3) different statuses
150, 152 and 154 as shown in Fig. 15. The display
status 150 represents that the relevant attribute
15   is not considered as the search target. The
attributes which are not considered as the search
target are displayed in neither the first network
display nor the second network display. In this
way, it is possible to limit the information
20   displayed. The display status 154 represents that
the relevant attribute is considered as the search
target and also that it is displayed as the
attribute node in the second network display.

In the display status of the first network 40
25   in Fig. 3, when the check boxes of the attribute
information list 44 for the attribute names V11,
V12 and V21 are configured to be the display status

154 which represents the attribute node display,
and the filtering button 38-1 is manipulated, the
network display area 38 will be converted to the
display status of the second network 76 as shown

5   in Fig. 7. For this second network 76, since the
attribute names V11, V12 and V21 which express the
edges 48-1, 48-2 and 48-3 in the first network 40
in Fig. 3 are designated as the attribute node
display targets, as shown by the display status 154

10   in Fig. 15, by the check boxes of the attribute
information list 44 in Fig. 3, when the filtering
for conversion to the second network is performed
by the manipulation of the filtering button 38-1,
all the edges 48-1 to 48-3 in the first network will

15   be represented by the attribute nodes 78-1, 78-2
and 78-3 and arranged as shown in the second network
76 of Fig. 7. Arrangement positions of the
attribute nodes 78-1 to 78-3 in the second network
76 are determined according to positions in the

20   attribute hierarchical structure in the attribute
information list 44 of Fig. 3 by manipulating the
layout button 38-2 in Fig. 3.

     Fig. 8 illustrates distances L1, L2 and L3
which indicate mutual positional relationship

25   between the attribute nodes 78-1 to 78-3 in the
second network 76. These distances L1, L2 and L3
which define the positional relations are based on

the positional relevance in the hierarchical
structure in the attribute information list 44 of
Fig. 3, and the attribute nodes 78-1 and 78-2 for
the attribute names V11 and V12 are adjoining and
5   this results in short distance L1. As opposed to
this, since the attribute node 78-3 for the
attribute name V21 is more distant from the
attribute nodes 78-1 and 78-2 for the attribute
names V11 and V12 in the hierarchical positions,
10   it is arranged with distances L2 and L3 which is
longer than the distance L1. Therefore, by looking
at mutual positional relationship between the
attribute nodes 78-1, 78-2 and 78-3, it is
understood at a glance that if the attribute node's
15   relationship is closer, the commonality is stronger,
and if it is more distant, the commonality is lower.
Referring to Fig. 7 again, the attribute nodes 78-1
to 78-3 which are arranged and represented in the
second network 76 perform the edge representation
20   for relations which are set to 1 in the edge display
flags 72 in the relevance information 20 of Fig.
6, between the element nodes 46-1 to 46-3 already
displayed in the network 40. Specifically, the
edges 80-1 to 80-7 are displayed as shown, from the
25   attribute nodes 78-1 to 78-3 to the element nodes
46-1 to 46-3 which possess respective attributes.
From this display of edges 80-1 to 80-7, it is known

that the attribute name V11 of the attribute node
78-1 is possessed by the element node 46-1 and the
element node 46-3. Also, it is known that the
attribute name V12 of the attribute node 78-2 is
5   possessed by the element node 46-1 and the element
node 46-2. Further, it is known that the attribute
name V21 of the attribute node 78-3 is possessed
by the element node 46-1, 46-2 and 46-3.

Fig. 9 is the display of the second network 76-1
10   which is displayed, in the case that the edges of
the first network 40 in Fig. 3 are displayed by the
attribute nodes, when the V21 is removed from the
attribute node display targets and the filtering
button 38-1 is manipulated. In this way, if the
15   second network 76-1 is displayed with the attribute
name V21 removed from the attribute node display
targets, remaining attribute names V11 and V12 are
displayed as the attribute nodes 78-1 and 78-2. It
is noted that the attribute node 78-3 of the
20   attribute name V21 is represented by dotted lines
for the purpose of easy-to-understand illustration,
but actually, the attribute node 78-3 is not
displayed. For the attributes in the attribute
node 78-3 which is not displayed, the structure of
25   the first network 40 is remain intact as the edges
48-1, 48-2 and 48-3 which represent that the
attribute ID = V005 is possessed by the element

nodes 46-1, 46-2 and 46-3. This way, in the
invention, it is possible to display the second
network, if necessary, in which all or some of the
edges representing the common attributes between
5   the element nodes in the first network 40 of Fig.
3 are designated as the attribute node display
targets. Naturally, in the display status of the
second network 76 and 76-1 in Fig.7 and Fig. 9, if
the attribute names V11 and V12 are further removed
10   from the attribute node display targets and the
filtering button 38-1 in Fig. 3 are manipulated,
then it is possible to go back to the former display
of the first network 40.

Fig. 10 is a flowchart of the information
15   relevance display process according to the
invention. In Fig. 10, first in step S1, the
element information and the attribute information
is input from the databases 14-1 to 14-3, and the
element information 16 such as Fig. 4 and the
20   attribute information 18 such as Fig. 5 is generated
and stored in the element information file 16-1 and
the attribute information file 18-1. Next, in step
S2, the element information and the attribute
information to be considered as the search targets
25   are designated based on the operation of the input
device by the user. Specifically, since the input
for designation is performed by the manipulation

of the check boxes in the element information list
42 on the display screen 36 of Fig.3 and the
manipulation of the check boxes in the hierarchical
structure in the attribute information list 44,

5   setup is performed based on this for the element
node display flags 55 in the element information
of Fig. 4 as well as for the attribute information
search flags 63 and attribute node display flags
64 in the attribute information of Fig. 5. Next,

10   in step S3, considering plural pieces of designated
element information as targets, common attribute
information for two (2) pieces of the element
information is extracted, and the relevance
information 20 such as Fig. 6 is generated and

15   stored in the relevance information file 20-1.
Subsequently, in step S4, it is checked whether the
designation for the first network display mode is
present or not, and if present, the first network
40 is displayed in step S5, in which the element

20   nodes are arranged and the edges are connected
between two (2) element nodes possessing common
attributes, as shown by the first network 40 in Fig.
3. Also, in step S6, if the designation for the
second network display mode is identified, then,

25   for example as shown in Fig. 7, the second network
76 is displayed, in which the edges corresponding
to the designated attributes in the first network

are converted into the attribute nodes, arranged
and displayed, and then the edges are connected
between the element nodes and the attribute nodes
for the possessed attributes thereof. These
5   processes of steps S2 to S7 are repeated until
termination direction is given in step S8.

More specifically, the users perform display
of the first network 40 as they change the
designations for plural pieces of the element
10 information and the attribute information to be
considered as the search targets accordingly,
convert the display into the second network display
in which the edges in the first network 40 are
converted into the attribute nodes and emphasized
15 if necessary, and analyze characteristics of the
search targets as they look at the network display.

Fig. 11 is a flowchart showing details of the
first network display process in step S5 of Fig.
10. In this first network display process, after
20 the display designation status of the elemental
nodes is identified in step S1, uniform arrangement
of the element nodes are determined in step S2.
Subsequently, if position corrections are directed
corresponding to the commonalities such as the
25 number of the common attributes in step S3, the
positions are corrected by means of the degrees of
the commonalities in step S4. For the arrangement

control of the elementa nodes in step S4, for
example the automatic arrangement of nodes in
Patent No. 3350223 may be utilized. Subsequently,
after arranging the element nodes which positions
5   are determined in step S5, the edges for the common
attributes are connected between the element nodes
in step S6.

Fig. 12 is a flowchart showing details of the
second network display process in step S7 in Fig.
10   10. In this second network display process, after
identifying display designation status of the
element nodes and the attribute nodes in step S1,
by referring to the relevance information 20 in Fig.
6, it is checked whether both of the connection
15   source nodes 66 and the connection destination
nodes 68 of the relevance information are in display
designation or not in step S2. At this point, if
the nodes are the element nodes, the element nodes
display flags 55 in the element information 16 in
20   Fig. 4 are referred for the display designation,
and if the nodes are the attribute nodes, the
attribute nodes display flags 64 in the attribute
information 18 in Fig. 5 are referred. If both of
the connection source nodes 66 and the connection
25   destination nodes 68 of the relevance information
are in display designation in step S2, then proceed
to step S3 and it is checked whether the common

attribute IDs are present or not. If the common
attribute IDs are present, since these are
relevance between the element nodes, determination
for mixing the first network display is needed. On
5   the other hand, if the common attribute IDs are not
present, since it will be second network display,
then proceed to step S6 and the edge display flags
72 is set to 1. If the common attribute IDs are
present in step S3, it is checked whether all the
10   common attribute IDs are displayed as the attribute
nodes in step S4. If all the common attribute IDs
are displayed as the attribute nodes, since the
first network display is not necessary, then
proceed to step S5 and the edge display flags are
15   reset to 0. If there is the common attribute ID
which is not displayed as the attribute node, since
the first network display is mixed, then proceed
to step S6 and the edge display flags are set to
1. In step S7, it is checked whether the relevance
20   IDs are identified in these steps S2 to S6 or not
for all the relevance IDs 65, which is R001 to R011
in this case, in the relevance information 20 of
Fig. 6, and if identified, proceed to step S8. In
step S8, the edges for the designated attributes
25   in the first network are converted into the
attribute nodes, and the converted attribute nodes
are arranged with distances corresponding to the

positions in the attribute hierarchical structure.
And in step S9, the edges which the edge display
flags 72 are set to 1 as shown in the relevance
information 20 of Fig. 6 are displayed between the
5   attribute nodes and the element nodes.

     Fig. 13 is a schematic diagram of a display
screen of the first network in the case that the
invention is applied to the relevance display of
gene information. On the display screen of Fig.
10   13, a first network 86 is displayed in a network
display area 84. Under the network display area
84, gene information is displayed as an element
information list 88. Also, on the left of the
network display area 84, an attribute information
15   list 90 is displayed, and attributes are provided
with check boxes to designate as targets.
Regarding to this, the element information list 88
is provided with check boxes on the left of each
gene as well. Further, an attribute appearance
20   frequency list 92 is provided. In the upper left
of the network display area 84, a filtering button
136 and a layout button 148 are provided. In this
display status of the first network 86, if the
filtering button 136 is manipulated, it is
25   converted to a display screen of a second network
94 shown in Fig. 14, for example. In this second
network 94, for the attribute hierarchical

structure in the attribute information list 90, the attribute nodes designated as the attribute node display targets are connected to the element nodes possessing the attributes thereof by the edges.

5   Although, in above embodiments, the display process of information relevance targeting gene information is taken as an example, the invention is not limited to this and can be directly applied to the analyses targeting the information in which

10   attribute information is added to appropriate element information, for example the analysis of personal purchasing information obtained as POS information in convenience stores, the analysis of patent information and the like.

15   Further, the invention includes any alteration not impairing the purpose and the benefit thereof and also is not limited by the numeric values shown in the above embodiments.

According to the invention described above,

20   with a first network in which nodes with common attributes are connected by edges in the situation that a plurality of element nodes are arranged, nodes at which the edges are concentrated can be comprehended as the nodes with high commonality at

25   a glance and can be comprehended as notable elements.

Also, by designating certain common attributes

under the display status of the first network and
displaying a second network in which edges
corresponding to common attributes are converted
into attribute nodes and arranged, data with strong
5 relevance are located near by each other, and it
is facilitated to comprehend data relevance
visually and intuitively.

Further, in arrangement of the attribute nodes
in the second network in which the edges in the first
10 network are converted into the attribute nodes, by
performing arrangement of the attribute nodes based
on a hierarchical structure or appearance
frequencies of attributes, it is facilitated to
narrow down attributes or attribute groups of
15 interest, and the discovery of new knowledge is
promoted.